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# IBM 1130 Synchronous Communications Adapter Subroutines

This publication supplements, and will later be incorporated into, IBM 1130 Subroutine Library (Form C26-5929).

This manual describes the subroutines used in connection with the 1130 Synchronous Communications Adapter, which permits the attachment of the 1130 Computing System to private and commercial common-carrier facilities.

Included in the descriptions are calling sequences for the subroutines and explanations of the parameters involved.

## PREFACE

This publication is composed of seven sections. The first section is a brief, general description of the IBM 1130 Synchronous Communications Adapter and the Synchronous Transmit-Receive and Binary Synchronous modes of communication. The second section provides a description of the calling sequences, control parameters, error handling, and functional operation of the SCAT1 subroutine, used for point-to-point communications in Synchronous Transmit-Receive mode. Sections three and four provide descriptions of the calling sequences, control parameters, error handling, and functional operation of the SCAT2 and SCAT3 subroutines, used for point-to-point and multi-point communications, respectively, in Binary Synchronous mode. The fifth and sixth sections are descriptions of the calling sequences, control parameters, and error handling for the printer subroutine PRNT2 and the subroutines that convert IBM card code and EBCDIC to 4-of-8 code and vice versa, HOL48 and EBC48. The seventh section is a sample program showing the use of the SCAT1 subroutine.

Also included in this publication are the procedures for operation of the 1130 Synchronous Communications Adapter and notes to the programmer using the Synchronous Communications Adapter subroutines.

The reader should be familiar with the following publications:

IBM 1130 Functional Characteristics (Form A26-5881) with Technical Newsletters N26-0143, N26-0156, and N26-0168.

IBM 1130 Computing System Input/Output Units (Form A26-5890).

IBM 1130 Assembler Language (Form C26-5927).

IBM 1130 Subroutine Library (Form C26-5929).

Data Communications Concepts and Communications Facilities (Form E20-8158).

General Information - Binary Synchronous Communications (Form A27-3004).

Third Edition (April 1967)

This publication (Form C26-3706-2) is a major revision of and makes obsolete the previous edition (Form C26-3706-1). Changes are designated as follows:

1. A vertical line appears to the left of affected text where only a part of the page has been changed.
2. A dot (•) appears to the left of the page number of a page that has been changed throughout.
3. A dot appears to the left of the title of a changed illustration.

The major changes in this publication are concerned with the inclusion of general information on Binary Synchronous Communications and the addition of the descriptions of the subroutines used to perform communications in Binary Synchronous mode.

Specifications contained herein are subject to change from time to time. Any such change will be reported in subsequent revisions or Technical Newsletters.

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A form is provided at the back of this publication for reader's comments. If the form has been removed, comments may be addressed to IBM Corporation, Programming Publications, Department 232, San Jose, California 95114.

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ILLUSTRATIONS

## THE SYNCHRONOUS COMMUNICATIONS ADAPTER

The Synchronous Communications Adapter enables the IBM 1130 Computing System to function as a data transmission station, using either private or commercial common-carrier line transmission facilities. The Adapter sends data to or receives data from the line transmission facilities under control of the stored program in the 1130. It operates on an interrupt-request basis similar to that used by the other input/output devices in the IBM 1130 Computing System.

## SYNCHRONOUS TRANSMIT-RECEIVE MODE

Synchronous Transmit-Receive (STR) communication is a control procedure for carrying out half-duplex, digital, serial-synchronous (by bit and by character) communication between two stations on point-to-point communication lines. The SCAT1 subroutine controls the 1130 Synchronous Communications Adapter (SCA) during operation in STR mode.

In STR mode, data may not have the same bit configurations as control characters. In addition, all data must be in 4-of-8 code; characters other than 4-of-8 code characters and STR control characters are treated as errors.

Error checking performed by the SCAT1 subroutine consists of an 8-bit Longitudinal Redundancy Check (LRC) accumulated from data characters. This subroutine also uses the alternating acknowledgement method for protection against the loss of blocks of data.

### STR Control Characters and Sequences

The STR control characters recognized by the SCAT1 subroutine are listed in Table 1.

The LRC character is exceptional:

1. The character may have any bit configuration. It is formed by performing an Exclusive OR of all the data characters in a record as each character is transmitted or received.
2. The character is not tested for validity. It is used in the LRC (Longitudinal Redundancy Check) performed at the receiving station, comparing the LRC character formed with the LRC character received at the end of the data record. Thus, the character is used as a checksum and is not tested.

Table 1. STR Control Characters

| Character | Bit Configuration | | | | | | | | Hex |
|---|---|---|---|---|---|---|---|---|---|
| | N | X | O | R | 8 | 4 | 2 | 1 | |
| IDLE | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 39 |
| TL | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 35 |
| CL | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 55 |
| INQ/ERR | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 59 |
| SOR1/ACK1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 53 |
| SOR2/ACK2 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 33 |
| *EOT | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 5A |
| *TEL | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 5C |
| LRC | - | - | - | - | - | - | - | - | - |

*Also may be used as data character

The STR control characters, when combined into the control sequences shown in Table 2, are used to control line functions; e.g., to acknowledge receipt of a message, to acknowledge synchronization, to signal the start of a message or the end of a transmission.

Table 2. STR Control Sequences

| | Leader | Trailer |
|---|---|---|
| End of Idle | CL | IDLE |
| Inquiry | TL | INQ |
| Start of Odd Record | TL | SOR1 |
| Start of Even Record | TL | SOR2 |
| End of Record | TL | LRC |
| Acknowledgment of Odd Record | CL | ACK1 |
| Acknowledgment of Even Record | CL | ACK2 |
| Error Received | CL | ERR |
| End of Transmission | CL | EOT |
| Telephone | CL | TEL |

## BINARY SYNCHRONOUS MODE

Binary Synchronous Communication (BSC) is a control procedure for carrying out half-duplex,

digital, serial-synchronous (by bit and by character) communication between two or more stations on point-to-point and multi-point communication lines. The SCAT2 subroutine controls the 1130 Synchronous Communications Adapter (SCA) during point-to-point operation in BSC mode; the SCAT3 subroutine controls the 1130 Synchronous Communications Adapter (SCA) during multi-point operation in BSC mode.

In the 1130 BSC mode, two types of text may be transmitted: Normal EBCDIC text and Full-Transparent text. In Normal EBCDIC text, data may not have the same bit configurations as control characters. In Full-Transparent text, data may have the same bit configurations as control characters since control character recognition is handled by a special procedure. This permits unrestricted coding of data within messages and is useful for sending binary data, decimal data, and the like.

In multi-point, centralized operation, the SCAT3 subroutine permits the 1130 to operate only as a slave station. Initialization is performed when the master station sends polling or selection addresses. A particular polling address gives a unique station on the line an opportunity to transmit to the master station. The polled station responds with a positive response (data transmission) or a negative response (EOT). Selection addresses are used to request a particular station to receive an ensuing data transmission. A selected station responds with its status: ready to receive (ACK0), or not ready to receive (NAK).

Error checking performed by the SCAT2 and SCAT3 subroutines consists of a 16-bit Cyclic Redundancy Check (CRC-16), accumulated from text and heading data. These subroutines also use the alternating acknowledgement method of protection against the loss of blocks of data.

## BSC Control Characters and Sequences

The BSC control characters recognized by the SCAT2 and SCAT3 subroutines when the 1130 is operating in Normal text mode, are listed in Table 3. The recognized control sequences appear in Table 4.

Table 3. BSC Control Characters

| Character | Meaning | Bit Configuration 0 1 2 3 4 5 6 7 | Hex |
|---|---|---|---|
| SYN | Synchranous Idle | 0 0 1 1 0 0 1 0 | 32 |
| DLE | Data Link Escope | 0 0 0 1 0 0 0 0 | 10 |
| ENQ | Enquiry | 0 0 1 0 1 1 0 1 | 2D |
| SOH | Stort af Heading | 0 0 0 0 0 0 0 1 | 01 |
| STX | Start of Text | 0 0 0 0 0 0 1 0 | 02 |
| ETB | End of Block | 0 0 1 0 0 1 1 0 | 26 |
| ETX | End of Text | 0 0 0 0 0 0 1 1 | 03 |
| EOT | End of Transmissian | 0 0 1 1 0 1 1 1 | 37 |
| NAK | Negative Acknowledgement | 0 0 1 1 1 1 0 1 | 3D |
| ACK0* | Pasitive Acknowledgement, Even Record | 0 1 1 1 0 0 0 0 | 70 |
| ACK1* | Positive Acknowledgement, Odd Record | 0 1 1 0 0 0 0 1 | 61 |

*Nat cantral choracters unless used in contral sequence os shown in Toble 5.

Table 4. BSC Control Sequences

| | |
|---|---|
| Enquiry | ENQ |
| Start of Heoding | SOH |
| Start of Text | STX |
| Start of Transparent Text | DLE STX |
| End af Black | ETB CRC-16 |
| End of Transparent Block | DLE ETB CRC-16 |
| End af Text | ETX CRC-16 |
| End af Transporent Text | DLE ETX CRC-16 |
| Acknowledgement of Odd Record | DLE ACK1 |
| Acknowledgement of Even Record | DLE ACK0 |
| Negative Acknowledgement | NAK |
| End af Tronsmission | EOT |
| Discannect Signal | DLE EOT |
| Synchronous Idle (Normol) | SYN |
| Synchronous Idle (Tronsparent Text) | DLE SYN |

The SCAT1 Interrupt Service Subroutine controls the 1130 SCA during point-to-point operation in STR mode and performs error checking on the data transmitted and received. A four digit control parameter directs the subroutine in the following:

- Testing to determine if the previous operation has been completed
- Establishing synchronism
- Transmitting
- Receiving
- Transmitting the appropriate type of acknowledgement
- Enabling/disabling the Auto Answer Interrupt feature
- Turning the audible alarm on and off
- Disconnecting the station from the line

## Calling Sequence

```
        LIBF    SCAT1
        DC      /XXXX   (Control Parameter)
        DC      IOAR    (I/O Area Address)
        DC      ERROR   (Error Routine Address)
        •       •
        •       •
        •       •
```

ERROR

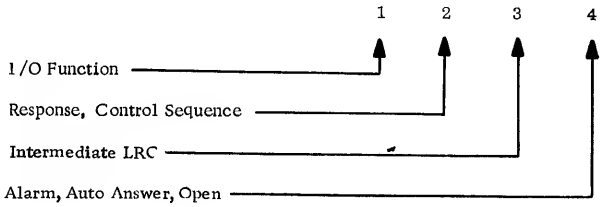
| Return Link |
|---|
| Error Routine |
| BSC I ERROR |

IOAR

| Word Count |
|---|
| I/O Area |

## Control Parameter

The control parameter consists of four hexadecimal digits which are used as shown below:




## I/O Function

The I/O function digit specifies the operation to be performed by SCAT1 on the SCA. The functions, their associated digital values, and the required parameters are listed and described below.

| Function | Digital Value | Required Parameters* |
|---|---|---|
| Test | 0 | Control |
| Auto Answer | 1 | Control, I/O Area** |
| Alarm | 2 | Control |
| Close | 3 | Control |
| Open | 4 | Control, I/O Area, Error |
| Transmit | 5 | Control, I/O Area, Error |
| Acknowledge and Receive | 6 | Control, I/O Area, Error |

*Any parameter not required for a particular function must be omitted.
**I/O area parameter needed if function is Enable Auto Answer.

Test. Tests the Device Routine Busy indicator and branches to LIBF+2 if the previous operation has not been completed, or to LIBF+3 if the previous operation has been completed.

It is possible to initiate an Auto Answer, Alarm, or Close operation while any Open, Transmit, or Receive operation is in progress.

Auto Answer. Enables the automatic answer interrupt if digit 4 of the control parameter is zero; disables the automatic answer interrupt if digit 4 of the control parameter is non-zero.

When an Auto Answer Request interrupt occurs, the location specified by the I/O area address is set to a non-zero value and the automatic answer interrupt is disabled.

Alarm. Turns on the audible alarm in the local system if digit 4 of the control parameter is zero; turns off the audible alarm if digit 4 is non-zero.

Close. Ends all operations on the SCA and disconnects the station from the line.

On carrier lines that require a station to disconnect from the line automatically at the end of message transmission, the user must perform a Close operation within two minutes of the transmission of EOT.

Open. Establishes synchronization. Digit 4 of the control parameter indicates whether the user plans to receive (Data In condition) or transmit (Data Out condition).

If digit 4 of the control parameter is zero (Data In), "handshaking" (exchanging IDLEs) continues until the INQ sequence is received. At this time, the Device Routine Busy indicator is cleared. When an INQ sequence is received, the user must initiate some Receive operation within 1.5 seconds in order to avoid any unnecessary line delay.

If digit 4 of the control parameter is non-zero (Data Out), the INQ sequence is transmitted after synchronization has been established. When the INQ acknowledgement sequence is received, the Device Routine Busy indicator is cleared. The user must initiate some Transmit operation within 1.5 seconds in order to avoid any unnecessary line delay.

When a station in the Open, Data Out condition receives an INQ sequence, a code ($4000_{16}$) is placed in the accumulator and a branch occurs to the error routine specified by the error routine address. If the user returns from the error routine with a non-zero accumulator, the INQ sequence is transmitted. Otherwise, SCAT1 performs a Close operation.

If the user attempts to synchronize but a Write Response does not occur (indicating that the data set is not ready), a code ($8000_{16}$) is placed in the accumulator and a branch occurs to the error routine. If the user returns from the error routine with a non-zero accumulator, SCAT1 attempts to synchronize again. Otherwise, SCAT1 performs a Close operation.

If the TEL sequence is received, a code ($1000_{16}$) is placed in the accumulator and a branch occurs to the error routine. Upon return from the error routine, SCAT1 transmits the TEL sequence, then resumes the synchronizing procedure.

If synchronization is not established after seven attempts, a code ($2000_{16}$) is placed in the accumulator and a branch occurs to the error routine. If the user returns from the error routine with a non-zero accumulator, SCAT1 makes seven more attempts to synchronize. If the user returns from the error routine with a zero accumulator, SCAT1 performs a Close operation.

Transmit. To transmit a data record, EOT sequence, or TEL sequence, digit 2 of the control parameter must be set to 0, 1, or 2, respectively. In addition, if ILRCs (Intermediate LRCs of groups of characters within a record) are to be provided with data record transmission, digit 3 of the control parameter must be non-zero. The Record Marks and Group Marks, which indicate the positions of the ILRCs, must be in the I/O area.

In a transmitted data record, the first word in the I/O area contains the word count for the data record. This word count represents the number of unpacked, left-justified, 4-of-8 characters in the data, including any Record Marks or Group Marks. If a non-data character or a 4-of-8 error is detected, SCAT1 transmits hexadecimal 1F, which forces an error at the receiving station. The hexadecimal 1F is not included in the LRC. Upon receiving the ERR sequence, SCAT1 places an error code ($0100_{16}$) in the accumulator and branches to the error routine. If the user returns from the error routine with a positive accumulator, the record is re-transmitted. If the accumulator is negative, SCAT1 continues as if the proper ACK sequence was received. If the accumulator is zero, SCAT1 performs a Close operation.

When the proper ACK sequence is received, SCAT1 transmits IDLEs and returns to the user. The user should initiate some Transmit or a Close operation within 1.5 seconds in order to avoid any unnecessary line delay.

If the ERR sequence is received in reply to a data record, the data record is re-transmitted. After seven unsuccessful tries, SCAT1 places an error code ($0400_{16}$) in the accumulator and branches to the error routine. If the user returns from the error routine with a positive accumulator, another series of seven tries is initiated. If the accumulator is negative, SCAT1 continues as if the proper ACK sequence was received. If the accumulator is zero, SCAT1 performs a Close operation.

If an incorrect control sequence is received on seven successive attempts, an error code ($0200_{16}$) is placed in the accumulator and a branch occurs to the error routine. If the user returns from the error routine with a positive accumulator, another series of seven tries is initiated. If the accumulator is negative, SCAT1 continues as if the proper ACK sequence was received. If the accumulator is zero, SCAT1 performs a Close operation.

If any sequence other than the proper ACK or ERR is received, the INQ sequence is transmitted.

Transmitting EOT and receiving the EOT sequence in reply causes SCAT1 to transmit IDLEs and return to the user program. The user should perform some Open or a Close operation within 1.5 seconds in order to avoid any unnecessary line delay. Any other sequence received in reply to a transmitted EOT results in the EOT sequence being re-transmitted.

Transmitting TEL and receiving the TEL sequence causes SCAT1 to transmit IDLEs and return to the user. The user should initiate some Open or Transmit or a Close operation within 1.5 seconds in order to avoid any unnecessary line delay. If any sequence other than TEL is received, the TEL sequence is re-transmitted.

Acknowledge and Receive. Acknowledges the previous record or INQ sequence and receives the next record.

If the user wishes to respond to the previous record or INQ sequence with a positive acknowledgement (ACK1 or ACK2 sequence), he must set digit 2 of the control parameter to zero. Otherwise, a negative acknowledgement (ERR sequence) is transmitted.

If the user expects Intermediate LRCs in the data, he must set digit 3 of the control parameter to any non-zero value.

The first word in the I/O area specifies the maximum word count for that area.

After the entire data record is received, the number of characters received in the record, including any Record Marks or Group Marks, is stored into the first word of the I/O area. If there were no errors in the record, SCAT1 transmits IDLEs, clears the Device Routine Busy indicator, and returns to the user program. The user should initiate some Acknowledge and Receive operation or a Close operation within 1.5 seconds in order to avoid any unnecessary line delay. The data is stored in the I/O area unpacked and left-justified.

If an error is detected in receiving the record (for example, an incorrect Start of Record, an invalid character, an incorrect LRC or ILRC, or an I/O area overflow), the ERR sequence is transmitted and SCAT1 tries to receive the record again. After seven attempts, an error code ($0800_{16}$) is placed in the accumulator and a branch occurs to the error routine. If the user returns from the error routine with a positive accumulator, another series of seven tries is initiated. If the accumulator is negative, SCAT1 continues as if there were no errors detected in receiving the record. If the accumulator is zero, SCAT1 performs a Close operation.

If an invalid character is received in the data, it is replaced by a blank character ($F0_{16}$).

If the EOT sequence is received, SCAT1 sets the first word of the I/O area to zero, transmits the EOT sequence, and returns to the Open, Data In condition.

If the TEL sequence is received, a code ($1000_{16}$) is placed in the accumulator and a branch occurs to the error routine. Upon return from the error routine, SCAT1 transmits the TEL sequence, then returns to the receive mode of operation.

Response, Control Sequence

Interpretation of control parameter digit 2 varies, depending on the setting of digit 1.

| Digit 1 | | Digit 2 | |
|---|---|---|---|
| Value | Meaning | Value | Meaning |
| 5 | Transmit | 0 | Transmit data record |
| 5 | Transmit | 1 | Transmit EOT sequence |
| 5 | Transmit | 2 | Transmit TEL sequence |
| 6 | Acknowledge and Receive | 0 | Transmit positive acknowledgement |
| 6 | Acknowledge and Receive | non-zero | Transmit negative acknowledgement |

Intermediate LRC

Control parameter digit 3 must be non-zero if the user desires to transmit or receive ILRCs.

Alarm, Auto Answer, Open

Interpretation of control parameter digit 4 varies, depending on the setting of digit 1.

| Digit 1 | | Digit 4 | |
|---|---|---|---|
| Value | Meaning | Value | Meaning |
| 1 | Auto Answer | 0 | Enable Auto Answer |
| 1 | Auto Answer | non-zero | Disable Auto Answer |
| 2 | Alarm | 0 | Turn on audible alarm |
| 2 | Alarm | non-zero | Turn off audible alarm |
| 4 | Open | 0 | Data In - user plans to receive |
| 4 | Open | non-zero | Data Out - user plans to transmit |

## Error Handling

For a description of error handling procedures, refer to General Error Handling Procedures in the publication IBM 1130 Subroutine Library.

The user should bear in mind that he must return from his error routine to SCAT1 within 1.5 seconds or unnecessary line delay is incurred.

## Pre-operation Error Detection

The following conditions result in pre-operation error action (accumulator settings are shown in parentheses):

- Invalid function code ($8001_{16}$)
- Invalid word count ($8001_{16}$)
- Receive operation not completed ($8002_{16}$)
- Transmit operation not completed ($8002_{16}$)
- Failure to establish synchronization before attempting to perform some Transmit or Receive operation ($8003_{16}$)
- Attempting to receive before receiving INQ sequence ($8003_{16}$)

## Post-operation Error Detection

The following conditions result in a branch to the user's error routine (accumulator settings are shown in parentheses):

- Failure to establish synchronization after seven attempts while trying to perform some Open operation, or INQ received in response to INQ ($2000_{16}$)
- Data set not ready ($8000_{16}$)
- Transmit error on seven tries ($0400_{16}$)
- Receive error, including I/O area overflow, on seven tries ($0800_{16}$)
- Error in data to be transmitted ($0100_{16}$)
- Incorrect control sequence received seven times ($0200_{16}$)

## Other Branches to Error Routine

The following conditions, although not classed as errors, result in a branch to the user's error routine (accumulator settings are shown in parentheses):

- Receiving a TEL sequence ($1000_{16}$)
- Receiving an INQ sequence while in Open, Data Out condition ($4000_{16}$)

The SCAT2 Interrupt Service Subroutine controls the 1130 SCA during point-to-point operation in BSC mode and performs error checking on the data transmitted and received. A four digit control parameter directs the subroutine in the following:

- Testing to determine if the previous operation has been completed
- Transmitting
- Receiving
- Turning the audible alarm on and off
- Enabling/disabling the Auto Answer Interrupt feature
- Disconnecting the station from the line

## Calling Sequence

```
        LIBF    SCAT2
        DC      /XXXX   (Control Parameter)
        DC      IOAR    (I/O Area Address)
        DC      ERROR   (Error Routine Address)
        .       .
        .       .
        .       .
```

ERROR

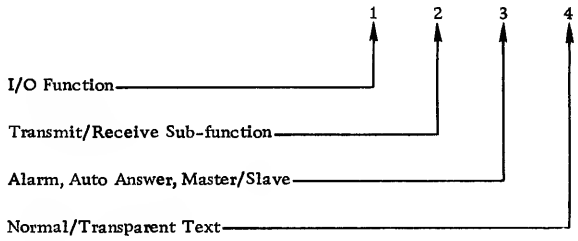
| Return Link |
|---|
| Error Routine |
| BSC I ERROR |

IOAR

| Word Count |
|---|
| I/O Area |

## Control Parameter

The control parameter consists of four hexadecimal digits which are used as shown below:




### I/O Function

The I/O function digit specifies the operation to be performed by SCAT2 on the SCA. The functions, their associated digital values, and the required parameters are listed and described below.

| Function | Digital Value | Required Parameters* |
|---|---|---|
| Test | 0 | Control |
| Auto Answer | 1 | Control, I/O Area** |
| Alarm | 2 | Control |
| Close | 3 | Control |
| Receive | 4 | Control, I/O Area, Error |
| Transmit Block | 5 | Control, I/O Area, Error |
| Transmit Text | 6 | Control, I/O Area, Error |
| Transmit End | 7 | Control, I/O Area, Error |

*Any parameter not required for a particular function must be omitted.
**I/O Area parameter required only if function is Enable Auto Answer.

Test. Tests the Device Routine Busy indicator and branches to LIBF+2 if the previous operation has not been completed, or to LIBF+3 if the previous operation has been completed.

It is possible to initiate a Test, Auto Answer, Alarm, or Close operation while any Transmit or Receive operation is in progress.

Auto Answer. Enables the automatic answer interrupt if digit 3 of the control parameter is zero; disables the automatic answer interrupt if digit 3 of the control parameter is non-zero.

When an Auto Answer Request interrupt occurs, the location specified by the I/O area address is set to a non-zero value and the automatic answer interrupt is disabled.

Alarm. Turns on the audible alarm in the local system if digit 3 of the control parameter is zero; turns off the audible alarm if digit 3 of the control parameter is non-zero.

Close. Ends all operations on the SCA and disconnects the station from the line.

On carrier lines that require a station to disconnect from the line automatically at the end of message transmission, the user must perform a Close operation within two minutes of the transmission of EOT.

Receive. A Receive operation can be one of three types. Digit 2 of the control parameter is used to specify which sub-function of Receive is requested.

| Digit 2 | Digital Value | Sub-function |
|---|---|---|
| | 0 | Receive Initial |
| | 1 | Receive Continue |
| | 2 | Receive Repeat |

- Receive Initial--Monitors the line for ENQ; upon receiving ENQ, transmits ACK0 and receives the message.
- Receive Continue--Transmits the correct positive acknowledgement for the current message and receives the next message.
- Receive Repeat--Transmits NAK for the current message and receives the next message.

When performing a Receive operation, the first word of the I/O area contains the maximum number of unpacked characters (word count) that can be read into that area.

The entire message that is received is stored in the I/O area, including the SOH character and/or the STX character (DLE STX, if Transparent text), the ETB character (DLE ETB, if Transparent text), or the ETX character (DLE ETX, if Transparent text). After the message has been received, the number of characters received, including control characters, is stored in the first word of the I/O area.

All characters in the I/O area are unpacked and left-justified.

If the record is received in Transparent text mode, SCAT2 deletes the second DLE character (inserted at the transmitting station) in each pair of DLE characters received.

If there were no errors in the message, SCAT2 clears the Device Routine Busy indicator and starts the 3-second timer. The user should initiate some Receive or a Close operation within 3 seconds in order to avoid any unnecessary line delay.

If the block check character (CRC-16) is found to be incorrect, if the message overflows the I/O area, or if a Receive timeout occurs while receiving the message, SCAT2 transmits NAK and attempts to receive the message again. After eight unsuccessful attempts, SCAT2 branches to the user's error routine with an error code in the accumulator (see Post-operation Error Detection). If the user returns with a positive accumulator, SCAT2 transmits NAK and attempts to receive the message again (up to seven more attempts before branching to the user's error routine). If the user returns with a zero accumulator, SCAT2 performs a Close operation. If the user returns with a negative accumulator, SCAT2 clears the Device Routine Busy indicator and stores the number of characters, including control characters, received in the message in the first word of the I/O area, allowing the user to initiate a Receive Repeat or Receive Continue operation.

If a timeout occurs while receiving a message, SCAT2 monitors for ENQ and, when ENQ is received, transmits the last acknowledgement.

If the EOT character is received, SCAT2 clears the first word of the I/O area to zero and clears the Device Routine Busy indicator. The user should then initiate a Receive Initial, Transmit Initial, Transmit EOT, Transmit DLE EOT (Dial line only), or Close operation.

If DLE EOT (Disconnect Signal) is received, SCAT2 sets the first word of the I/O area to $FFFF_{16}$ and performs a Close operation.

Transmit Block/Text. There are four types of Transmit Block and Transmit Text operations. Digits 2 and 4 of the control parameter are used to specify which sub-function of Transmit Block/Text is requested.

| Digit 2 | Digital Value | Sub-function |
|---|---|---|
| | 0 | Transmit Initial |
| | 1 | Transmit Continue |

| Digit 4 | Digital Value | Sub-function |
|---|---|---|
| | 0 | Normal EBCDIC text |
| | non-zero | Full-Transparent text |

- Transmit Initial Block/Text--Transmits ENQ, receives the acknowledgement (ACK0), transmits the message from the I/O area, transmits the CRC-16, and receives the acknowledgement (ACK1).

- Transmit Initial Transparent Block/Text--Transmits ENQ, receives the acknowledgement (ACK0), transmits the message from the I/O area, transmits DLE ETB/DLE ETX, transmits the CRC-16, and receives the acknowledgement (ACK1).

- Transmit Continue Block/Text--Transmits the message from the I/O area, transmits the CRC-16, and receives the acknowledgement.

- Transmit Continue Transparent Block/Text--Transmits the message from the I/O area, transmits DLE ETB/DLE ETX, transmits the CRC-16, and receives the acknowledgement.

Contention exists when the two stations on a line simultaneously bid for control of the line by performing the Transmit Initial operation at the same time. In a 4-wire system, each station receives ENQ in response to its ENQ. In a 2-wire system, neither station receives a response and a timeout occurs at both stations. The two contending stations should have slightly different timeout periods such that, in re-transmitting ENQ, the contending station having the longer timeout period eventually receives ENQ in response to its ENQ.

SCAT2 provides a means to break contention. If the user wishes to be the master station in the event of contention, digit 3 of the control parameter must be zero. If the user wishes to be the slave station, digit 3 of the control parameter must be non-zero.

In a master station, when contention exists, SCAT2 re-transmits ENQ. After eight attempts, SCAT2 branches to the user's error routine with an error code ($4000_{16}$) in the accumulator. If the user returns from the error routine with a non-zero accumulator, SCAT2 attempts to break contention seven more times. If the user returns with a zero accumulator, SCAT2 performs a Close operation.

In a slave station, when contention exits, SCAT2 branches to the user's error routine with an error code ($4000_{16}$) in the accumulator and, upon return from the error routine, performs a Close operation, allowing the user to initiate a Receive Initial operation.

When performing a Transmit Block/Text operation, the first word of the I/O area contains the number of characters in the message. The character count includes the control characters in the message. All characters in the I/O area are unpacked and left-justified. If the user wishes to start the message with a heading (optional), he must supply the SOH character as the first character of the message.

If there is text in the message, the text portion of the message follows the heading. When digit 4 of the control parameter is zero, the text is Normal EBCDIC text and must begin with STX and end with ETB/ETX. The user must supply these characters. When digit 4 of the control parameter is non-zero, the text is Full-Transparent text and must begin with DLE STX. The user must supply these characters. The ending characters, DLE ETB/ETX, are supplied by SCAT2. SCAT2 transmits a second DLE character after each DLE that is found in the Transparent text.

If a redundancy check of the heading separate from the text is desired, the heading must end with ETB. The ETB is supplied by the user.

The I/O area is not checked for misplaced or incorrect control characters.

SCAT2 transmits the 16-bit block check character (CRC-16) after the ETB/ETX is transmitted. The CRC-16 is generated by SCAT2.

When the proper acknowledgement is received, SCAT2 clears the Device Routine Busy indicator and starts the 3-second timer. The user should initiate some Transmit operation (except Transmit Initial) or a Close operation within 3 seconds in order to avoid any unnecessary line delay.

If ACK0 is not received in response to the initial ENQ, ENQ is re-transmitted, except when contention exists and the station is a slave station.

If NAK is received in response to a message, the message is re-transmitted.

If EOT is received in response to ENQ or to a message, SCAT2 clears the first word of the I/O area to zero and clears the Device Routine Busy indicator, allowing the user to initiate a Receive Initial, Transmit Initial, Transmit End, or Close operation.

If DLE EOT is received in response to ENQ or to a message, SCAT2 sets the first word of the I/O area to $FFFF_{16}$ and performs a Close operation.

If anything other than EOT, DLE EOT, NAK, or a positive acknowledgement is received in response to a message, ENQ is transmitted. If the incorrect positive acknowledgement is received, SCAT2 re-transmits the message if a Receive timeout occurred after the message was transmitted; SCAT2 transmits ENQ if no Receive timeout occurred.

If, after eight attempts, the proper positive acknowledgement is not received, SCAT2 branches to the user's error routine with an error code in the accumulator (see Post-operation Error Detection). If the user returns from the error routine with a positive accumulator, the transmission is attempted seven more times. If the user returns with a zero accumulator, SCAT2 performs a Close operation. If the user returns with a negative accumulator, SCAT2 continues as if the proper positive acknowledgement had been received.

Transmit End. The Transmit End operation can be one of two types. Digit 2 of the control parameter is used to specify which sub-function of Transmit End is requested.

| Digit 2 | Digital Value | Sub-function |
|---|---|---|
| | 0 | Transmit EOT |
| | 1 | Transmit DLE EOT |

- Transmit EOT--Transmits EOT, then reacts according to the reply received.
- Transmit DLE EOT--Transmits DLE EOT, then performs a Close operation.

On a Transmit EOT operation, SCAT2 transmits EOT and receives the response. If the response is DLE EOT, SCAT2 performs a Close operation. If there is no response (a Receive timeout occurs), SCAT2 performs a Close operation. If the response is EOT, SCAT2 stores an EOT character in the location specified by the I/O area address and clears the Device Routine Busy indicator, allowing the user to initiate a Transmit Initial, Transmit DLE EOT, or Close operation. If the response is ENQ, SCAT2 stores ENQ in the location specified by the I/O area address and clears the Device Routine Busy indicator, allowing the user to initiate a Receive Continue or Receive Repeat operation.

If a response other than DLE EOT, EOT, or ENQ is received, SCAT2 re-transmits EOT. After eight unsuccessful attempts, SCAT2 branches to the user's error routine. If the user returns with a non-zero accumulator, transmission is attempted seven more times. If the user returns with a zero accumulator, SCAT2 performs a Close operation.

Transmit/Receive Sub-function

The interpretation of digit 2 of the control parameter varies, depending on the setting of digit 1.

| Digit 1 | | Digit 2 | |
|---|---|---|---|
| Value | Meaning | Value | Meaning |
| 4 | Receive | 0 | Receive Initial |
| 4 | Receive | 1 | Receive Continue |
| 4 | Receive | 2 | Receive Repeat |
| 5 | Transmit Block | 0 | Transmit Initial Block |
| 5 | Transmit Block | 1 | Transmit Continue Block |
| 6 | Transmit Text | 0 | Transmit Initial Text |
| 6 | Transmit Text | 1 | Transmit Continue Text |
| 7 | Transmit End | 0 | Transmit EOT |
| 7 | Transmit End | 1 | Transmit DLE EOT |

Alarm, Auto Answer, Master/Slave

The interpretation of digit 3 of the control parameter varies, depending on the setting of digit 1 and digit 2.

| Digit 1 | | Digit 2 | | Digit 3 | |
|---|---|---|---|---|---|
| Value | Meaning | Value | Meaning | Value | Meaning |
| 1 | Auto Answer | * | * | 0 | Enable Auto Answer |
| 1 | Auto Answer | * | * | non-zero | Disable Auto Answer |
| 2 | Alarm | * | * | 0 | Alarm on |
| 2 | Alarm | * | * | non-zero | Alarm off |
| 5 | Transmit Block | 0 | Initial | 0 | Master station, if contention |
| 5 | Transmit Block | 0 | Initial | non-zero | Slave station, if contention |
| 5 | Transmit Block | 1 | Continue | * | * |
| 6 | Transmit Text | 0 | Initial | 0 | Master station, if contention |
| 6 | Transmit Text | 0 | Initial | non-zero | Slave station, if contention |
| 6 | Transmit Text | 1 | Continue | * | * |

*Not applicable

Normal/Transparent Text

Digit 4 of the control parameter specifies the text mode for the data to be transmitted.

| Digit 4 | Digital Value | Text Mode |
|---|---|---|
| | 0 | Normal EBCDIC text |
| | non-zero | Full-Transparent text |

Error Handling

For a description of error handling procedures, refer to General Error Handling Procedures in the publication IBM 1130 Subroutine Library.

Pre-operation Error Detection

The following conditions result in pre-operation error action (accumulator settings are shown in parentheses):

- Invalid function code ($8001_{16}$)
- Invalid sub-function code for some Transmit or Receive operation ($8001_{16}$)
- Invalid word count ($8001_{16}$).

Post-operation Error Detection

The following conditions result in a branch to the user's error routine (accumulator settings are shown in parentheses):

- Data set not ready ($8000_{16}$)
- Contention exists ($4000_{16}$)
- 3-second timeout occurred while receiving a message or monitoring for ENQ, or ENQ not received while monitoring for ENQ ($2000_{16}$)
- I/O area overflow ($1000_{16}$)
- Block check character (CRC-16) in error ($0800_{16}$)
- Receive timeout occurred after transmitting a message or ENQ, or invalid sequence received in response to a message or ENQ ($0200_{16}$)
- NAK received, or the incorrect acknowledgement received following a Receive timeout ($0400_{16}$)
- Incorrect acknowledgement received with no Receive timeout ($0100_{16}$)

The SCAT3 Interrupt Service Subroutine controls the 1130 SCA during multi-point operation and performs error checking on the data transmitted and received. A four digit control parameter directs the subroutine in the following:

- Testing to determine if the previous operation has been completed
- Monitoring the line for the specified polling address and selection address
- Transmitting
- Receiving
- Turning the audible alarm on and off
- Disconnecting the station from the line

## Calling Sequence

The calling sequence for all I/O functions except Monitor (see I/O Function) is as follows:

```
          LIBF      SCAT3
          DC        /XXXX     (Control Parameter)
          DC        IOAR      (I/O Area Address)
          DC        ERROR     (Error Routine Address)
          •         •
          •         •
          •         •
```

ERROR

| Return Link |
|---|
| Error Routine |
| BSC I ERROR |

IOAR

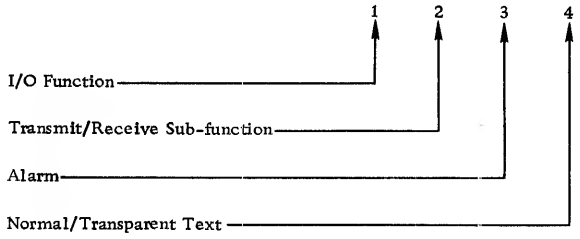
| Word Count |
|---|
| I/O Area |

The calling sequence for the Monitor I/O function (see I/O Function) is as follows:

```
          LIBF      SCAT3
          DC        /1000     (Control Parameter)
          DC        POLL      (Polling Address Parameter)
          DC        SELCT     (Selection Address Parameter)
          •         •
          •         •
          •         •
POLL      DC        /XX00     (Polling Address)
          DC        0
          •         •
          •         •
          •         •
SELCT     DC        /YY00     (Selection Address)
          DC        0
```

## Control Parameter

The control parameter consists of four hexadecimal digits which are used as shown below:




## I/O Function

The I/O function digit specifies the operation to be performed by SCAT3 on the SCA. The functions, their associated digital values, and the required parameters are listed and described below.

| Function | Digital Value | Required Parameters* |
|---|---|---|
| Test | 0 | Control |
| Monitor | 1 | Control, I/O Area, Error |
| Alarm | 2 | Control |
| Close | 3 | Control |
| Receive | 4 | Control, I/O Area, Error |
| Transmit Block | 5 | Control, I/O Area, Error |
| Transmit Text | 6 | Control, I/O Area, Error |
| Transmit EOT | 7 | Control |

*Any parameter not required for a particular function must be omitted.

Test. Tests the Device Routine Busy indicator and branches to LIBF+2 if the previous operation has not been completed, or to LIFB+3 if the previous operation has been completed.

It is possible to initiate a Test, Alarm, or Close operation while a Monitor, any Transmit, or any Receive operation is in progress.

Monitor. Monitors the line for the specified polling address and selection address.

The polling address and the selection address are limited to one character each; this character must not be a control character.

The polling address parameter specifies the location of the polling address. The polling address must be left-justified. The word following the polling address is used for storing a non-zero indication that the polling address was received on the line.

The selection address parameter specifies the location of the selection address. The selection address must be left-justified. The word following the selection address is used for storing a non-zero indication that the selection address was received on the line.

If the polling address is received, EOT is transmitted, a non-zero indication is stored in the word following the polling address, and SCAT3 continues monitoring.

If the selection address is received, NAK is transmitted, a non-zero indication is stored in the word following the selection address, and SCAT3 continues monitoring.

A Monitor operation must be initiated before the first Transmit Initial or Receive Initial. The Monitor operation does not turn on the Device Routine Busy indicator.

Alarm. Turns on the audible alarm in the local system if digit 3 of the control parameter is zero; turns off the audible alarm if digit 3 of the control parameter is non-zero.

Close. Ends all operations on the SCA and disconnects the station from the line.

Receive. A Receive operation can be one of three types. Digit 2 of the control parameter is used to specify which sub-function of Receive is requested.

| Digit 2 | Digital Value | Sub-function |
|---|---|---|
| | 0 | Receive Initial |
| | 1 | Receive Continue |
| | 2 | Receive Repeat |

- Receive Initial--Monitors the line for the specified selection address followed by ENQ; upon receiving the selection address and ENQ, transmits ACK0 and receives the message.
- Receive Continue--Transmits the correct positive acknowledgement for the current message and receives the next message.
- Receive Repeat--Transmits NAK for the current message and receives the next message.

When performing a Receive operation, the first word of the I/O area contains the maximum number of unpacked characters (word count) that can be read into that area.

The entire message that is received is stored in the I/O area, including the SOH character and/or the STX character (DLE STX, if Transparent text), the ETB character (DLE ETB, if Transparent text), or the ETX character (DLE ETX, if Transparent text). After the message has been received, the number of characters received, including control characters, is stored in the first word of the I/O area.

All characters in the I/O area are unpacked and left-justified.

If the record is received in Transparent text mode, SCAT3 deletes the second DLE character (inserted at the transmitting station) in each pair of DLE characters received.

If there were no errors in the message, SCAT3 clears the Device Routine Busy indicator and starts the 3-second timer. The user should initiate some Receive operation within 3 seconds in order to avoid any unnecessary line delay.

If the block check character (CRC-16) is found to be incorrect, if the message overflows the I/O area, or if a Receive timeout occurs while receiving the message, SCAT3 transmits NAK and attempts to receive the message again. After eight unsuccessful attempts, the subroutine branches to the user's error routine with an error code in the accumulator (see Post-operation Error Detection). If the user returns with a positive accumulator, the subroutine transmits NAK and attempts to receive the message again (up to seven more attempts before branching to the user's error routine). If the user returns with a zero accumulator, SCAT3 returns to the monitoring operation. If the user returns with a negative accumulator, SCAT3 clears the Device Routine Busy indicator and stores the number of characters, including control characters, received in the message in the first word of the I/O area, allowing the user to initiate a Monitor, Receive Continue, Receive Repeat, Transmit Initial, or Close operation.

If the EOT character is received, SCAT3 clears the first word of the I/O area to zero, clears the Device Routine Busy indicator, and returns to the monitoring operation. The user may then initiate a Transmit Initial, Receive Initial, or Close operation. If no operation is initiated, SCAT3 continues monitoring.

If, while monitoring for the selection address, the polling address is received, SCAT3 transmits EOT, stores a non-zero indication in the location following the polling address specified in the last Monitor operation initiated (see Monitor), and continues monitoring for the selection address.

Transmit Block/Text. There are four types of Transmit Block and Transmit Text operations. Digits 2 and 4 of the control parameter are used to specify which sub-function of Transmit Block/Text is requested.

| Digit 2 | Digital Value | Sub-function |
|---|---|---|
| | 0 | Transmit Initial |
| | 1 | Transmit Continue |

| Digit 4 | Digital Value | Sub-function |
|---|---|---|
| | 0 | Normal EBCDIC text |
| | non-zero | Full-Transparent text |

- Transmit Initial Block/Text--Monitors the line for the specified polling address followed by ENQ; upon receiving the polling address and ENQ, transmits the message from the I/O area, transmits the CRC-16, and receives the acknowledgement (ACK1).

- Transmit Initial Transparent Block/Text--Monitors the line for the specified polling address followed by ENQ; upon receiving the polling address and ENQ, transmits the message from the I/O area, transmits DLE ETB/DLE ETX, transmits the CRC-16, and receives the acknowledgement (ACK1).

- Transmit Continue Block/Text--Transmits the message from the I/O area, transmits the CRC-16, and receives the acknowledgement.

- Transmit Continue Transparent Block/Text--Transmits the message from the I/O area, transmits DLE ETB/DLE ETX, transmits the CRC-16, and receives the acknowledgement.

When performing a Transmit Block/Text operation, the first word of the I/O area contains the number of characters in the message. The character count includes the control characters in the message. All characters in the I/O area are unpacked and left-justified. If the user wishes to start the message with a heading (optional), he must supply the SOH character as the first character of the message.

If there is text in the message, the text portion of the message follows the heading. When digit 4 of the control parameter is zero, the text is Normal EBCDIC text and must begin with STX and end with ETB/ETX. The user must supply these characters. When digit 4 of the control parameter is non-zero, the text is Full-Transparent text and must begin with DLE STX. The user must supply these characters. The ending characters, DLE ETB/DLE ETX are supplied by SCAT3. SCAT3 transmits a second DLE character after each DLE that is found in the Transparent text.

If a redundancy check of the heading separate from the text is desired, the heading must end with ETB. The ETB is supplied by the user.

The I/O area is not checked for misplaced or incorrect control characters.

SCAT3 transmits the 16-bit block check character (CRC-16) after the ETB/ETX is transmitted. The CRC-16 is generated by SCAT3.

If NAK is received in response to a message, the message is re-transmitted.

If EOT is received in response to ENQ or to a message, SCAT3 clears the first word of the I/O area to zero, clears the Device Routine Busy indicator, and returns to the monitoring operation. The user may then initiate a Receive Initial, Transmit Initial, or Close operation. If no operation is initiated, SCAT3 continues monitoring.

If anything other than EOT, NAK, or a positive acknowledgement is received in response to a message, ENQ is transmitted. If the incorrect positive acknowledgement is received, SCAT3 re-transmits the message if a Receive timeout occurred after the message was transmitted; SCAT3 transmits ENQ if no Receive timeout occurred.

If, after eight attempts, the proper positive acknowledgement is not received, SCAT3 branches to the user's error routine with an error code in the accumulator (see Post-operation Error Detection). If the user returns from the error routine with a positive accumulator, the transmission is attempted seven more times. If the user returns with a zero accumulator, SCAT3 returns to the monitoring operation. If the user returns with a negative accumulator, SCAT3 continues as if the proper positive acknowledgement was received.

When the proper acknowledgement is received, SCAT3 clears the Device Routine Busy indicator and starts the 3-second timer. The user should initiate some Transmit operation within 3 seconds in order to avoid any unnecessary line delay.

If, while monitoring for the polling address, the selection address is received, SCAT3 transmits NAK, stores a non-zero indication in the location following the selection address specified in the last Monitor operation initiated (see Monitor), and continues monitoring for the polling address.

Transmit EOT. Transmits EOT and returns to the monitoring operation.

Transmit/Receive Sub-function

The interpretation of digit 2 of the control parameter varies, depending on the setting of digit 1.

| Digit 1 | | Digit 2 | |
|---|---|---|---|
| Value | Meaning | Value | Meaning |
| 4 | Receive | 0 | Receive Initial |
| 4 | Receive | 1 | Receive Continue |
| 4 | Receive | 2 | Receive Repeat |
| 5 | Transmit Block | 0 | Transmit Initial Block |
| 5 | Transmit Block | 1 | Transmit Continue Block |
| 6 | Transmit Text | 0 | Transmit Initial Text |
| 6 | Transmit Text | 1 | Transmit Continue Text |

Alarm

Digit 3 of the control parameter specifies the requested condition of the Audible Alarm.

| Digit 3 | Digital Value | Alarm Condition |
|---|---|---|
| | 0 | on |
| | non-zero | off |

Normal/Transparent Text

Digit 4 of the control parameter specifies the text mode for the data being transmitted.

| Digit 4 | Digital Value | Text Mode |
|---|---|---|
| | 0 | Normal EBCDIC text |
| | non-zero | Full-Transparent text |

Error Handling

For a description of error handling procedures, refer to General Error Handling Procedures in the publication IBM 1130 Subroutine Library.

Pre-operation Error Detection

The following conditions result in pre-operation error action (accumulator settings are shown in parentheses):

- Invalid function code ($8001_{16}$)
- Invalid sub-function code for some Transmit or Receive operation ($8001_{16}$)
- Invalid word count ($8001_{16}$)

Post-operation Error Detection

The following conditions result in a branch to the user's error routine (accumulator settings are shown in parentheses):

- Data set not ready ($8000_{16}$)
- 3-second timeout occurred while receiving a message ($2000_{16}$)
- I/O area overflow ($1000_{16}$)
- Block check character (CRC-16) in error ($0800_{16}$)
- Receive timeout occurred after transmitting a message or ENQ, or invalid sequence received in response to a message or ENQ ($0200_{16}$)
- NAK received, or the incorrect acknowledgement received following a Receive timeout ($0400_{16}$)
- Incorrect acknowledgement received with no Receive timeout ($0100_{16}$)

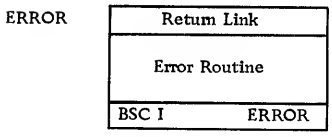
The printer subroutine PRNT2 is an additional printer subroutine for the IBM 1132 Printer, specifically provided to permit concurrent operation of the 1132 and the Synchronous Communications Adapter. PRNT2 handles all print and carriage control functions related to the 1132.

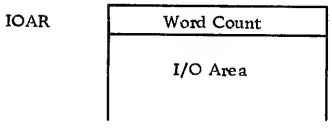
Only one line of data can be printed, or one carriage operation executed, with each call to the printer subroutine. The data in the output area must be in EBCDIC form, packed two characters per word.

Restriction. The PRNT1 and PRNT2 subroutines are mutually exclusive; i.e., both subroutines may not be in core at the same time. Thus, if the Synchronous Communications Adapter is in operation, the PRNT2 subroutine must be used for concurrent operation of the 1132 Printer. If the PRNT2 subroutine is required in a coreload for the concurrent operation of the 1132 Printer and the Adapter, all IBM- and user-written programs in that coreload using the PRNT1 subroutine must be modified to use the PRNT2 subroutine.

## Calling Sequence

```
        LIBF    PRNT2
        DC      /XXXX   (Control Parameter)
        DC      IOAR    (I/O Area Address)
        DC      ERROR   (Error Routine Address)
        •       •
        •       •
        •       •
```

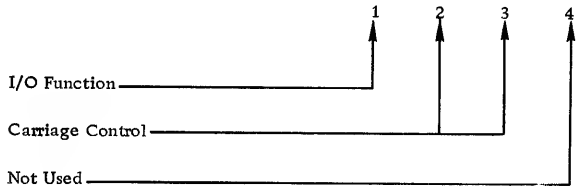



The calling sequence parameters are described in the following paragraphs.

### Control Parameter

The control parameter consists of four hexadecimal digits which are used as shown below:




### I/O Function

The I/O function digit specifies the operation to be performed on an 1132 Printer. The functions, their associated digital values, and the required parameters are listed and described below.

| Function | Digital Value | Required Parameters* |
|---|---|---|
| Test | 0 | Control |
| Print | 2 | Control, I/O Area, Error |
| Control Carriage | 3 | Control |
| Print Numerical | 4 | Control, I/O Area, Error |

*Any parameter not required for a particular function must be omitted.

Test. Branches to LIBF+2 if the previous operation has not been completed or to LIBF+3 if the previous operation has been completed.

Print. Prints characters from the user's I/O area; checks for channel 9 and 12 indications. If either of these conditions is detected, the subroutine branches to the user's error routine after the line of data has been printed. Upon return from this

error routine, a skip to channel 1 is initiated or the operation is terminated, depending upon whether the accumulator is non-zero or zero.

Control Carriage. Controls the carriage as specified by the carriage control digits listed in Table 5.

Print Numerical. Prints only numerals and special characters from the user's I/O area and checks for channel 9 and channel 12 indications. See Print above.

### Carriage Control

Digits 2 and 3 specify the carriage control operations listed in Table 5. An immediate request is executed before the next print operation; an after-print request is executed after the next print operation and replaces the normal space operation.

If the I/O function is Print, only digit 3 is examined; if the I/O function is Control Carriage, and digits 2 and 3 both specify carriage operations, only digit 2 is used.

### I/O Area Parameter

The I/O area parameter is the label of the control word that precedes the user's I/O area. The control word consists of a word count that specifies the number of words of data to be printed. The data must be in EBCDIC format, packed two characters per word.

### Error Parameter

See Calling Sequence for format.

### Error Handling

For a description of error handling procedures, refer to General Error Handling Procedures in the publication IBM 1130 Subroutine Library.

### Pre-operation Error Detection

The following conditions result in pre-operation error action (accumulator settings are shown in parentheses):

Table 5. Carriage Control Operations

| Digit #2: Immediate Carriage Operations |
|---|
| Print Functions<br>Not Used<br><br>Control Function<br><br>1 - Immediate Skip To Channel 1<br>2 - Immediate Skip To Channel 2<br>3 - Immediate Skip To Channel 3<br>4 - Immediate Skip To Channel 4<br>5 - Immediate Skip To Channel 5<br>6 - Immediate Skip To Channel 6<br>9 - Immediate Skip To Channel 9<br>C - Immediate Skip To Channel 12<br>D - Immediate Space Of 1<br>E - Immediate Space Of 2<br>F - Immediate Space Of 3 |
| **Digit #3: After-Print Carriage Operations** |
| Print Functions<br><br>0 - Space One Line After Printing<br>1 - Suppress Space After Printing<br><br>Control Function<br><br>1 - Skip After Print To Channel 1<br>2 - Skip After Print To Channel 2<br>3 - Skip After Print To Channel 3<br>4 - Skip After Print To Channel 4<br>5 - Skip After Print To Channel 5<br>6 - Skip After Print To Channel 6<br>9 - Skip After Print To Channel 9<br>C - Skip After Print To Channel 12<br>D - Space 1 After Print<br>E - Space 2 After Print<br>F - Space 3 After Print |

- 1132 not ready ($6000_{16}$)
- End of forms ($6000_{16}$)
- Invalid control parameter ($6001_{16}$)
- Invalid word count ($6001_{16}$)

### Post-operation Error Detection

The following conditions result in a branch to the user's error routine (accumulator settings are shown in parentheses):

- Channel 9 detected ($0003_{16}$)
- Channel 12 detected ($0004_{16}$)

HOL48

This subroutine converts IBM card code to the 4-of-8 code or converts the 4-of-8 code to IBM card code (see Appendix A). Only the 64 data characters specified in 4-of-8 code are recognized and converted. Any others are converted to the blank character.

## Calling Sequence

```
LIBF    HOL48
DC      /XXXX   (Control Parameter)
DC      INPUT   (Input Area Address)
DC      OTPUT   (Output Area Address)
DC      NNNN    (Character count)
```

## Control Parameter

The control parameter consists of four hexadecimal digits. Digits 1-3 are not used and must be zero. The fourth digit specifies the direction of conversion:

0 – IBM card code to 4-of-8 code
1 – 4-of-8 code to IBM card code.

## Input

Input is either IBM card code or 4-of-8 code (as specified by the control parameter), starting at location INPUT. IBM card code characters are stored one character per word. 4-of-8 characters are stored one character per word, left-justified.

## Output

Output is either IBM card code or 4-of-8 code, starting at location OTPUT. Characters are stored as described under Input. The address INPUT must be equal to or greater than the address OTPUT. The subroutine starts processing at location INPUT.

## Character Count

This number specifies the number of characters to be converted and is equal to the number of words required for INPUT and OTPUT.

## Errors Detected

No errors are detected during conversion of 4-of-8 code to IBM card code. The SCAT1 subroutine detects any invalid characters in the data being transmitted or received and causes an exit to the error routine upon detection. Hence, only valid 4-of-8 characters reach the I/O area.

In the conversion of IBM card code to 4-of-8 code, any input character that does not conform to one of the 64 4-of-8 characters is replaced in the output buffer by the blank character.

Conversion is not terminated when an error is detected; the Carry indicator is turned off and the Overflow indicator is turned on before returning control to the user. Otherwise, the Carry and Overflow indicators are not changed by the conversion subroutines.

## Additional Subroutines and Tables

HOL48 uses a conversion subroutine (HXCV) and two tables (STRTB, HOLCA), all three of which reside in the subroutine library.

HXCV. Converts 4-of-8 code to a table of displacements.

STRTB. A table consisting of 4-of-8 and EBCDIC codes.

HOLCA. A table consisting of IBM card codes.

EBC48

This subroutine converts EBCDIC characters to the 4-of-8 code or converts the 4-of-8 code to EBCDIC code (see Appendix A). Only the 64 data characters available in the 4-of-8 code are recognized and converted. Any others are converted to the blank character.

## Calling Sequence

```
LIBF    EBC48
DC      /XXXX   (Control Parameter)
DC      INPUT   (Input Area Address)
DC      OTPUT   (Output Area Address)
DC      NNNN    (Character count)
```

## Control Parameter

The control parameter consists of four hexadecimal digits. Digits 1-3 are not used and must be zero. The fourth digit specifies the direction of conversion:

0 – EBCDIC to 4-of-8 code
1 – 4-of-8 code to EBCDIC.

## Input

Input is either EBCDIC characters or 4-of-8 characters (as specified by the control parameter), starting at location INPUT. EBCDIC characters must be packed two characters per word; 4-of-8 characters are stored one character per word, left-justified.

## Output

Output is either EBCDIC characters or 4-of-8 characters, starting at location OTPUT. Characters are packed as described in Input.

If the direction of the conversion is 4-of-8 code to EBCDIC output, the input area can overlap the output area if the address INPUT is equal to or greater than the address OTPUT. If the direction of the conversion is EBCDIC input to 4-of-8 output, the input area can overlap the output area if the address INPUT+n/2 is equal to or greater than the address OTPUT+n, when n is the character count specified. The subroutine starts processing at location INPUT.

## Character Count

This number specifies the number of EBCDIC characters (packed two per word) or the number of 4-of-8 characters (one per word) to be converted. If an odd count is specified for EBCDIC output, bits 8 through 15 of the last word in the output area are set to an indeterminate value.

## Errors Detected

No errors are detected during conversion of 4-of-8 code to EBCDIC. The SCAT1 subroutine detects any invalid characters in the data being transmitted or received and causes an exit to the error routine upon detection. Hence, only valid 4-of-8 characters reach the I/O area.

In the conversion of EBCDIC to 4-of-8 code, any input character that does not conform to one of the 64 4-of-8 characters is replaced in the output buffer by the blank character.

Conversion is not terminated when an error is detected; the Carry indicator is turned off and the Overflow indicator is turned on before returning control to the user. Otherwise, the Carry and Overflow indicators are not changed by the conversion subroutines.

## Additional Subroutines and Tables

EBC48 uses a conversion subroutine (HXCV) and a table (STRTB), both of which reside in the subroutine library.

HXCV. Converts 4-of-8 code to a table of displacements.

STRTB. A table consisting of 4-of-8 and EBCDIC codes.

The following is a sample program showing the use of the SCAT1 subroutine to perform data transmission and reception in STR mode.

```
// JOB                                                                  SMSTR001
// ASM                                                                  SMSTR002
*LIST                                                                   SMSTR003
*PRINT SYMBOL TABLE                                                     SMSTR004
                         ABS                                            SMSTR005
0438                     ORG     /0300                                  SMSTR006
                    *  IBM 1130 MONITOR SCAT SAMPLE PROGRAM             SMSTR007
                    *                        * OPEN, DATA IN            SMSTR008
                    *                        * RECEIVE                  SMSTR009
                    *                        * CONVERT TO EBC           SMSTR010
                    *                        * PRINT                    SMSTR011
                    *                        * LOOP TO RECEIVE UNTIL    SMSTR012
                    *                          EOT                      SMSTR013
                    *                                                   SMSTR014
0300 0  3000        PART1 WAIT                                          SMSTR015
                    *                                                   SMSTR016
0301 20 176558F2            LIBF    PRNT2       SKIP TO CHANNEL 1       SMSTR017
0302 0  3100                DC      /3100                               SMSTR018
                    *                                                   SMSTR019
0303 20 220C18F1            LIBF    SCAT1                               SMSTR020
0304 0  4000                DC      /4000       OPEN, DATA IN           SMSTR021
0305 0  0000                DC      0                                   SMSTR022
0306 0  03B4                DC      OPENX                               SMSTR023
                    *                                                   SMSTR024
0307 20 220C18F1            LIBF    SCAT1                               SMSTR025
0308 0  0000                DC      /0000       LOOP UNTIL NOT BUSY     SMSTR026
0309 0  70FD                MDX     *-3                                 SMSTR027
                    *                                                   SMSTR028
030A 00 C40003B4            LD   L  OPENX                               SMSTR029
030C 00 4C2003BA            BSC  L  ER1,Z       BR. IF ERROR IN OPEN    SMSTR030
                    *                                                   SMSTR031
030E 0  C029        LOOPA   LD      D81         RESTORE WORD COUNT      SMSTR032
030F 0  D029                STO     A                                   SMSTR033
0310 20 220C18F1            LIBF    SCAT1                               SMSTR034
0311 0  6000                DC      /6000       RECEIVE                 SMSTR035
0312 0  0339                DC      A                                   SMSTR036
0313 0  03C6                DC      RCVX                                SMSTR037
                    *                                                   SMSTR038
0314 20 220C18F1            LIBF    SCAT1                               SMSTR039
0315 0  0000                DC      /0000       LOOP UNTIL NOT BUSY     SMSTR040
0316 0  70FD                MDX     *-3                                 SMSTR041
                    *                                                   SMSTR042
0317 00 C40003C6            LD   L  RCVX                                SMSTR043
0319 00 4C2003CD            BSC  L  ER2,Z       BR. IF ERROR IN RECEIVE SMSTR044
                    *                                                   SMSTR045
031B 0  C01D        CONT    LD      A                                   SMSTR046
031C 00 4C1803E0            BSC  L  EOT,&-      BR IF END OF TRANSMISSION SMSTR047
031E 00 C40003C6            LD   L  RCVX                                SMSTR048
0320 00 4C180326            BSC  L  PNTR,&-                             SMSTR049
0322 0  1010                SLA     16                                  SMSTR050
0323 00 D40003C6            STO  L  RCVX                                SMSTR051
0325 0  70E8                MDX     LOOPA                               SMSTR052
                    *                                                   SMSTR053
0326 0  C012        PNTR    LD      A                                   SMSTR054
0327 0  D007                STO     COUNT       NUMBER OF CHARACTERS RCVED SMSTR055
0328 0  1801                SRA     1                                   SMSTR056
0329 00 D400038B            STO  L  PRNT        NUMBER OF WORDS TO PRINT SMSTR057
                    *                                                   SMSTR058
032B 20 05083D38            LIBF    ERC48                               SMSTR059
032C 0  0001                DC      /0001       CONVERT 4/8 TO EBCDIC   SMSTR060
032D 0  033A                DC      A&1         4/8 AREA                SMSTR061
032E 0  038C                DC      PRNT&1      EBCDIC AREA             SMSTR062
032F 0  0000        COUNT   DC      *-*         CHARACTER COUNT         SMSTR063
                    *                                                   SMSTR064
0330 20 176558F2            LIBF    PRNT2                               SMSTR065
0331 0  0000                DC      /0000       LOOP UNTIL NOT BUSY     SMSTR066
0332 0  70FD                MDX     *-3                                 SMSTR067
                    *                                                   SMSTR068
0333 20 176558F2            LIBF    PRNT2                               SMSTR069
0334 0  2000                DC      /2000       PRINT 1 RECORD          SMSTR070
0335 0  038B                DC      PRNT                                SMSTR071
0336 0  03DD                DC      PRNTX                               SMSTR072
                    *                                                   SMSTR073
0337 0  70D6                MDX     LOOPA       GO TO RECEIVE           SMSTR074
                    *                                                   SMSTR075
0338 0  0051        D81     DC      &81                                 SMSTR076
```

```
0339 0  0051        A      DC      &81                                    SMSTR077
033A    0051               BSS     81                                     SMSTR078
                    *                                                     SMSTR079
038B 0  0000        PRNT   DC      *-*                                    SMSTR080
038C    0028               BSS     40                                     SMSTR081
                    *                                                     SMSTR082
03B4 0  0000        OPENX  DC      0          ERROR ROUTINE FOR OPEN      SMSTR083
03B5 0  D023               STO     CODE                                   SMSTR084
03B6 00 440005A4           BSI  L  TYPIT      GO TYPE ERROR CODE          SMSTR085
03B8 00 4C8003B4           BSC  I  OPENX                                  SMSTR086
                    *                                                     SMSTR087
03BA 0  C01E        ER1    LD      CODE                                   SMSTR088
03BB 0  901E               S       H1000                                  SMSTR089
03BC 00 4C20030E           BSC  L  LOOPA,Z                                SMSTR090
                    *                                                     SMSTR091
03BE 20 220C18F1    TEL    LIBF    SCAT1                                  SMSTR092
03BF 0  3000               DC      /3000      CLOSE OPERATION             SMSTR093
03C0 0  C01A               LD      HCCCC      OPEN - TEL                  SMSTR094
03C1 0  3000        WAIT   WAIT                                           SMSTR095
03C2 0  1010               SLA     16                                     SMSTR096
03C3 0  D0F0               STO     OPENX                                  SMSTR097
03C4 00 4C000300           BSC  L  PART1                                  SMSTR098
                    *                                                     SMSTR099
03C6 0  0000        RCVX   DC      0          ERROR ROUTINE FOR RECEIVE   SMSTR100
03C7 0  D011               STO     CODE                                   SMSTR101
03C8 00 440005A4           BSI  L  TYPIT      GO TYPE ERROR CODE          SMSTR102
03CA 0  C010               LD      HCCCC      ACCEPT BAD RECORD           SMSTR103
03CB 00 4C8003C6           BSC  I  RCVX                                   SMSTR104
                    *                                                     SMSTR105
03CD 0  C00B        ER2    LD      CODE                                   SMSTR106
03CE 0  900B               S       H1000                                  SMSTR107
03CF 00 4C20031B           BSC  L  CONT,Z                                 SMSTR108
                    *                                                     SMSTR109
03D1 20 220C18F1    TEL2   LIBF    SCAT1                                  SMSTR110
03D2 0  3000               DC      /3000      CLOSE OPERATION             SMSTR111
03D3 0  C008               LD      HEEEE      RCV - TEL                   SMSTR112
03D4 0  3000        WAIT2  WAIT                                           SMSTR113
03D5 0  1010               SLA     16                                     SMSTR114
03D6 0  D0EF               STO     RCVX                                   SMSTR115
03D7 00 4C000300           BSC  L  PART1                                  SMSTR116
                    *                                                     SMSTR117
03D9 0  0000        CODE   DC      0                                      SMSTR118
03DA 0  1000        H1000  DC      /1000                                  SMSTR119
03DB 0  CCCC        HCCCC  DC      /CCCC                                  SMSTR120
03DC 0  EEEE        HEEEE  DC      /EEEE                                  SMSTR121
03DD 0  0000        PRNTX  DC      0                                      SMSTR123
03DE 00 4C8003DD           BSC  I  PRNTX                                  SMSTR124
                    *                                                     SMSTR125
03E0 20 176558F2    EOT    LIBF    PRNT2                                  SMSTR126
03E1 0  2000               DC      /2000      PRINT END OF JOB            SMSTR127
03E2 0  03E6               DC      END                                    SMSTR128
03E3 0  03DD               DC      PRNTX                                  SMSTR129
03E4 00 4C0003F9           BSC  L  PART2                                  SMSTR130
03E6 0  0011        END    DC      END1-END-1                             SMSTR131
03E7    0021               EBC     .THIS IS THE END OF THIS TEST CASE.    SMSTR132
03F8 0  0000        END1   DC      0                                      SMSTR133
                    *                          1. OPEN FUNCTION         SMSTR134
                    *                             DATA OUT ONLY         SMSTR135
                    *                          2. TEST FUNCTION         SMSTR136
                    *                          3. TRANSMIT FUNCTION     SMSTR137
                    *                             DATA                  SMSTR138
                    *                          4. TRANSMIT FUNCTION     SMSTR139
                    *                             EOT                   SMSTR140
                    *                          5. CLOSE FUNCTION        SMSTR141
                    *                                                   SMSTR142
03F9 20 03059131    PART2  LIBF    CARD1      READ CARD INTO BUFFER 1     SMSTR143
03FA 0  1000               DC      /1000                                  SMSTR144
03FB 0  044B               DC      BUF1                                   SMSTR145
03FC 0  058F               DC      CDERR                                  SMSTR146
                    *                                                     SMSTR147
03FD 20 220C18F1           LIBF    SCAT1                                  SMSTR148
03FE 0  4001               DC      /4001      OPEN, DATA OUT              SMSTR149
03FF 0  0000               DC      0                                      SMSTR150
0400 0  03B4               DC      OPENX                                  SMSTR151
                    *                                                     SMSTR152
0401 20 03059131    LOOP   LIBF    CARD1                                  SMSTR153
0402 0  0000               DC      /0000      LOOP UNTIL CARD HAS         SMSTR154
0403 0  70FD               MDX     *-3            BEEN READ               SMSTR155
                    *                                                     SMSTR156
0404 20 08593D38           LIBF    HOL48                                  SMSTR157
0405 0  0000               DC      /0000      CONVERT BUF1 TO 4 OF 8      SMSTR158
0406 0  044C               DC      BUF1&1         IN XMIT1                SMSTR159
0407 0  04EE               DC      XMIT1&1                                SMSTR160
0408 0  0050               DC      &80                                    SMSTR161
                    *                                                     SMSTR162
0409 00 44010444           BSI  L  CONVT,0    BRANCH IF ERROR IN CONVERT  SMSTR163
```

```
                         *                                                                  SMSTR164
040B 20 220C18F1         LOOP     LIBF    SCAT1      LOOP UNTIL SYNCHRONIZATION          SMSTR165
040C 0  0000                      DC      /0000      IS ESTABLISHED OR                   SMSTR166
040D 0  70FD                      MDX     *-3        TRANSMISSION IS COMPLETE            SMSTR167
                         *                                                                  SMSTR168
040E 0  C03B                      LD      LAST                                           SMSTR169
040F 00 4C200415                  BSC  L  X1,Z       BRANCH ON LAST CARD                 SMSTR170
                         *                                                                  SMSTR171
0411 20 03059131                  LIBF    CARD1      READ CARD INTO BUFFER 2             SMSTR172
0412 0  1000                      DC      /1000                                          SMSTR173
0413 0  049C                      DC      BUF2                                           SMSTR174
0414 0  058F                      DC      CDERR                                          SMSTR175
                         *                                                                  SMSTR176
0415 20 220C18F1         X1       LIBF    SCAT1      TRANSMIT DATA FROM XMIT1            SMSTR177
0416 0  5000                      DC      /5000                                          SMSTR178
0417 0  04ED                      DC      XMIT1                                          SMSTR179
0418 0  0597                      DC      XMITX                                          SMSTR180
                         *                                                                  SMSTR181
0419 0  C030                      LD      LAST                                           SMSTR182
041A 00 4C200437                  BSC  L  END2,Z     LAST CARD, SEND EOT                 SMSTR183
                         *                                                                  SMSTR184
041C 20 03059131                  LIBF    CARD1      LOOP UNTIL CARD HAS                 SMSTR185
041D 0  0000                      DC      /0000          BEEN READ                       SMSTR186
041E 0  70FD                      MDX     *-3                                            SMSTR187
                         *                                                                  SMSTR188
041F 20 08593D38                  LIBF    HOL48                                          SMSTR189
0420 0  0000                      DC      /0000                                          SMSTR190
0421 0  049D                      DC      BUF2&1     CONVERT BUF2 TO 4 OF 8              SMSTR191
0422 0  053F                      DC      XMIT2&1            IN XMIT2                    SMSTR192
0423 0  0050                      DC      &80                                            SMSTR193
                         *                                                                  SMSTR194
0424 00 44010444                  BSI  L  CONVT,0    BRANCH IF ERROR IN CONVERT          SMSTR195
                         *                                                                  SMSTR196
0426 20 220C18F1                  LIBF    SCAT1      LOOP UNTIL TRANSMISSION             SMSTR197
0427 0  0000                      DC      /0000          IS COMPLETE                     SMSTR198
0428 0  70FD                      MDX     *-3                                            SMSTR199
                         *                                                                  SMSTR200
0429 0  C020                      LD      LAST                                           SMSTR201
042A 00 4C200430                  BSC  L  X2,Z       BRANCH ON LAST CARD                 SMSTR202
                         *                                                                  SMSTR203
042C 20 03059131                  LIBF    CARD1      READ CARD INTO BUFFER 1             SMSTR204
042D 0  1000                      DC      /1000                                          SMSTR205
042E 0  044B                      DC      BUF1                                           SMSTR206
042F 0  058F                      DC      CDERR                                          SMSTR207
                         *                                                                  SMSTR208
0430 20 220C18F1         X2       LIBF    SCAT1      TRANSMIT DATA FROM XMIT2            SMSTR209
0431 0  5000                      DC      /5000                                          SMSTR210
0432 0  053E                      DC      XMIT2                                          SMSTR211
0433 0  0597                      DC      XMITX                                          SMSTR212
                         *                                                                  SMSTR213
0434 0  C015                      LD      LAST                                           SMSTR214
0435 00 4C180401                  BSC  L  LOOP,&-    NOT LAST CARD SO CONTINUE           SMSTR215
                         *                                                                  SMSTR216
0437 20 220C18F1         END2     LIBF    SCAT1      LOOP UNTIL TRANSMIT IS              SMSTR217
0438 0  0000                      DC      /0000          COMPLETE                        SMSTR218
0439 0  70FD                      MDX     END2                                           SMSTR219
                         *                                                                  SMSTR220
043A 20 220C18F1                  LIBF    SCAT1      TRANSMIT EOT                        SMSTR221
043B 0  5100                      DC      /5100                                          SMSTR222
043C 0  0000                      DC      0                                              SMSTR223
043D 0  059E                      DC      EOTX                                           SMSTR224
                         *                                                                  SMSTR225
043E 20 220C18F1                  LIBF    SCAT1      LOOP UNTIL TRANSMIT IS              SMSTR226
043F 0  0000                      DC      /0000          COMPLETE                        SMSTR227
0440 0  70FD                      MDX     *-3                                            SMSTR228
                         *                                                                  SMSTR229
0441 20 220C18F1                  LIBF    SCAT1      CLOSE UP SHOP.                      SMSTR230
0442 0  3000                      DC      /3000                                          SMSTR231
                         *                                                                  SMSTR232
0443 0  3000                      WAIT               END OF JOB                          SMSTR233
                         *                                                                  SMSTR234
0444 0  0000             CONVT    DC      0                                              SMSTR235
0445 00 74010449                  MDX  L  ERCNT,&1   ADD TO CONVERSION ERRORS            SMSTR236
0447 00 4C800444                  BSC  I  CONVT                                          SMSTR237
                         *                                                                  SMSTR238
0449 0  0000             ERCNT    DC      0                                              SMSTR239
044A 0  0000             LAST     DC      0                                              SMSTR240
                         *                                                                  SMSTR241
044B 0  0050             BUF1     DC      &80        CARD BUFFER 1                       SMSTR242
044C    0050                      BSS     80                                             SMSTR243
                         *                                                                  SMSTR244
049C 0  0050             BUF2     DC      &80        CARD BUFFER 2                       SMSTR245
049D    0050                      BSS     80                                             SMSTR246
                         *                                                                  SMSTR247
04ED 0  0050             XMIT1    DC      &80        CAT BUFFER 1                        SMSTR248
04EE    0050                      BSS     80                                             SMSTR249
```

```
                        *
053E 0  0050    XMIT2   DC      680         CAT BUFFER 2
053F    0050            BSS     80
                        *
058F 0  0000    CDERR   DC      0
0590 00 4CA0058F        BSC   I CDERR,Z
0592 0  C000            LD      *           LAST CARD WAS READ
0593 00 D400044A        STO   L LAST
0595 00 4C80058F        BSC   I CDERR
                        *
0597 0  0000    XMITX   DC      0
0598 0  D00A            STO     CODE1
0599 00 440005A4        BSI   L TYPIT       GO TYPE ERROR CODE
059B 0  C006            LD      H8000       GET NEXT RECORD
059C 00 4C800597        BSC   I XMITX
                        *
059E 0  0000    EOTX    DC      0
059F 0  D003            STO     CODE1
05A0 00 4C80059E        BSC   I EOTX
                        *
05A2 0  8000    H8000   DC      /8000
05A3 0  0000    CODE1   DC      0
                        *
05A4 0  0000    TYPIT   DC      *-*         TYPE ERROR CODE
05A5 0  6108            LDX     1 8
05A6 0  1140            SLCA    1           FIND WHICH CODE IT IS
05A7 00 C50005B3        LD    L1 CATTB      PUT TILT-ROTATE
05A9 0  D007            STO     CATAR&2     CODE IN BUFFER
05AA 20 26663A30        LIBF    WRTYO       TYPE
05AB 0  2000            DC      /2000
05AC 0  05AF            DC      CATAR
05AD 00 4C8005A4        BSC   I TYPIT       RETURN
05AF 0  0003    CATAR   DC      3           TYPEWRITER BUFFER
05B0 0  81BC            DC      /81BC       NL,/
05B1 0  0000            DC      *-*         WORD FROM CATTB
05B2 0  C4C4            DC      /C4C4       /00
05B3            CATTB   EQU     *           TILT-ROTATE CODES
05B3 0  C4C4            DC      /C4C4       /00
05B4 0  C4FC            DC      /C4FC       /01
05B5 0  C4D8            DC      /C4D8       /02
05B6 0  C4F0            DC      /C4F0       /04
05B7 0  C4E4            DC      /C4E4       /08
05B8 0  FCC4            DC      /FCC4       /10
05B9 0  D8C4            DC      /D8C4       /20
05BA 0  F0C4            DC      /F0C4       /40
05BB 0  E4C4            DC      /E4C4       /80
                        *
                        *
05BC    0300            END     PART1
```

SMSTR250 SMSTR251 SMSTR252 SMSTR253 SMSTR254 SMSTR255 SMSTR256 SMSTR257 SMSTR258 SMSTR259 SMSTR260 SMSTR261 SMSTR262 SMSTR263 SMSTR264 SMSTR265 SMSTR266 SMSTR267 SMSTR268 SMSTR269 SMSTR270 SMSTR271 SMSTR272 SMSTR273 SMSTR274 SMSTR275 SMSTR276 SMSTR277 SMSTR278 SMSTR279 SMSTR280 SMSTR281 SMSTR282 SMSTR283 SMSTR284 SMSTR285 SMSTR286 SMSTR287 SMSTR288 SMSTR289 SMSTR290 SMSTR291 SMSTR292 SMSTR293 SMSTR294 SMSTR295 SMSTR296 SMSTR297 SMSTR298

SYMBOL TABLE

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A | 0339 | BUF1 | 044B | BUF2 | 049C | CATAR | 05AF |
| CATTB | 05B3 | CDERR | 058F | CODE | 03D9 | CODE1 | 05A3 |
| CONT | 031B | CONVT | 0444 | COUNT | 032F | D81 | 0338 |
| END | 03E6 | END1 | 03F8 | END2 | 0437 | EOT | 03E0 |
| EOTX | 059E | ER1 | 03BA | ER2 | 03CD | ERCNT | 0449 |
| H1000 | 03DA | H8000 | 05A2 | HCCCC | 03DB | HEEEE | 03DC |
| LAST | 044A | LOOP | 0401 | LOOPA | 030E | OPENX | 03B4 |
| PART1 | 0300 | PART2 | 03F9 | PNTR | 0326 | PRNT | 038B |
| PRNTX | 03DD | RCVX | 03C6 | TEL | 03BE | TEL2 | 03D1 |
| TYPIT | 05A4 | WAIT | 03C1 | WAIT2 | 03D4 | XMITX | 0597 |
| XMIT1 | 04ED | XMIT2 | 053E | X1 | 0415 | X2 | 0430 |

NO ERRORS IN ABOVE ASSEMBLY.

| Graphics and Control Names | EBCDIC Binary 0213 | EBCDIC Binary 4567 | EBCDIC Hex | IBM Card Code Rows 12 | 11 | 0 | 9 | 8 | 7-1 | IBM Card Code Hex | 4 - of - 8 Code N | X | O | R | 8 | 4 | 2 | 1 | 4 - of - 8 Code Hex |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (space) | 0100 | 0000 | 40 | | | no punches | | | | 0000 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | F0 |
| ¢ | | 1010 | 4A | 12 | | | | 8 | 2 | 8820 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 6A |
| . (period) | | 1011 | 4B | 12 | | | | 8 | 3 | 8420 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 8B |
| < | | 1100 | 4C | 12 | | | | 8 | 4 | 8220 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 6C |
| ( | | 1101 | 4D | 12 | | | | 8 | 5 | 8120 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 56 |
| + | | 1110 | 4E | 12 | | | | 8 | 6 | 80A0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 36 |
| \| (logical OR) (Group Mark) | | 1111 | 4F | 12 | | | | 8 | 7 | 8060 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 8D |
| & | 0101 | 0000 | 50 | 12 | | | | | | 8000 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 8E |
| ! | | 1010 | 5A | | 11 | | | 8 | 2 | 4820 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | CA |
| $ | | 1011 | 5B | | 11 | | | 8 | 3 | 4420 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 4B |
| * | | 1100 | 5C | | 11 | | | 8 | 4 | 4220 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | CC |
| ) (TEL) | | 1101 | 5D | | 11 | | | 8 | 5 | 4120 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 5C |
| ; | | 1110 | 5E | | 11 | | | 8 | 6 | 40A0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 3C |
| ¬ (logical NOT) | | 1111 | 5F | | 11 | | | 8 | 7 | 4060 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 4D |
| - (dash) | 0110 | 0000 | 60 | | 11 | | | | | 4000 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 4E |
| / | | 0001 | 61 | | | 0 | | | 1 | 3000 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | B1 |
| , (camma) | | 1011 | 6B | | | 0 | | 8 | 3 | 2420 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 2B |
| % | | 1100 | 6C | | | 0 | | 8 | 4 | 2220 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | AC |
| _ (underscore) (EOT) | | 1101 | 6D | | | 0 | | 8 | 5 | 2120 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 5A |
| > | | 1110 | 6E | | | 0 | | 8 | 6 | 20A0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 3A |
| ? | | 1111 | 6F | | | 0 | | 8 | 7 | 2060 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 2D |
| : | 0111 | 1010 | 7A | | | | | 8 | 2 | 0820 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 2E |
| # | | 1011 | 7B | | | | | 8 | 3 | 0420 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1B |
| @ | | 1100 | 7C | | | | | 8 | 4 | 0220 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 9C |
| ' (apostrophe) | | 1101 | 7D | | | | | 8 | 5 | 0120 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0F |
| = | | 1110 | 7E | | | | | 8 | 6 | 00A0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1E |
| " | | 1111 | 7F | | | | | 8 | 7 | 0060 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1D |
| A | 1100 | 0001 | C1 | 12 | | | | | 1 | 9000 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 71 |
| B | | 0010 | C2 | 12 | | | | | 2 | 8800 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 72 |
| C | | 0011 | C3 | 12 | | | | | 3 | 8400 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 63 |
| D | | 0100 | C4 | 12 | | | | | 4 | 8200 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 74 |
| E | | 0101 | C5 | 12 | | | | | 5 | 8100 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 65 |
| F | | 0110 | C6 | 12 | | | | | 6 | 8080 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 66 |
| G | | 0111 | C7 | 12 | | | | | 7 | 8040 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 87 |
| H | | 1000 | C8 | 12 | | | | 8 | | 8020 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 78 |
| I | | 1001 | C9 | 12 | | | 9 | | | 8010 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 69 |
| J | 1101 | 0001 | D1 | | 11 | | | | 1 | 5000 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | D1 |
| K | | 0010 | D2 | | 11 | | | | 2 | 4800 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | D2 |
| L | | 0011 | D3 | | 11 | | | | 3 | 4400 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | C3 |
| M | | 0100 | D4 | | 11 | | | | 4 | 4200 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | D4 |
| N | | 0101 | D5 | | 11 | | | | 5 | 4100 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | C5 |
| O | | 0110 | D6 | | 11 | | | | 6 | 4080 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | C6 |
| P | | 0111 | D7 | | 11 | | | | 7 | 4040 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 47 |
| Q | | 1000 | D8 | | 11 | | | 8 | | 4020 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | D8 |
| R | | 1001 | D9 | | 11 | | 9 | | | 4010 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | C9 |
| (Record Mark) | 1110 | 0000 | E0 | | | 0 | | 8 | 2 | 2820 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | AA |
| S | | 0010 | E2 | | | 0 | | | 2 | 2800 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | B2 |
| T | | 0011 | E3 | | | 0 | | | 3 | 2400 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | A3 |
| U | | 0100 | E4 | | | 0 | | | 4 | 2200 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | B4 |
| V | | 0101 | E5 | | | 0 | | | 5 | 2100 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | A5 |
| W | | 0110 | E6 | | | 0 | | | 6 | 2080 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | A6 |
| X | | 0111 | E7 | | | 0 | | | 7 | 2040 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 27 |
| Y | | 1000 | E8 | | | 0 | | 8 | | 2020 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | B8 |
| Z | | 1001 | E9 | | | 0 | 9 | | | 2010 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | A9 |
| 0 | 1111 | 0000 | F0 | | | 0 | | | | 2000 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 9A |
| 1 | | 0001 | F1 | | | | | | 1 | 1000 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | E1 |
| 2 | | 0010 | F2 | | | | | | 2 | 0800 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | E2 |
| 3 | | 0C11 | F3 | | | | | | 3 | 0400 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 93 |
| 4 | | 0100 | F4 | | | | | | 4 | 0200 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | E4 |
| 5 | | 0101 | F5 | | | | | | 5 | 0100 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 95 |
| 6 | | 0110 | F6 | | | | | | 6 | 0080 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 96 |
| 7 | | 0111 | F7 | | | | | | 7 | 0040 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 17 |
| 8 | | 1000 | F8 | | | | | 8 | | 0020 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | E8 |
| 9 | | 1001 | F9 | | | | 9 | | | 0010 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 99 |

## APPENDIX B. OPERATING PROCEDURES

To prepare for the execution of a communications program, the user must:

1. Prepare the program for execution.
2. Prepare the 1130 Console and Operator Panel.
   a. Turn the Speed Selection switch to the desired Baud rate
   b. Set the STR-BSC switch to the STR position for communication in Synchronous Transmit-Receive mode, to the BSC position for communication in Binary Synchronous mode.
   c. Set the CE Mode switch to the OFF position.
   d. Set the Audible Alarm switch to the ON position.
3. Prepare the Data Set.
   a. Check to ensure that the Data Set is connected to the power supply (the AC Input is plugged in).
   b. Check to ensure that the OPER/TEST switch on the plug in the back of the Data Set is set to the OPER position.
   c. Establish communication (required in point-to-point operation only).
      1. If this is the calling station,
         a. Lift the receiver and press the TALK button.
         b. Dial the other station.
         c. When the Data-tone (a continuous, high-pitched buzz) is heard, press the DATA button. When the DATA button is lighted, communication is established.
      2. If this is the station to be called
         a. and Auto Answer is desired, press the AUTO button. When this station is dialed, the DATA button is lighted (communication is established).
         b. and Auto Answer is not desired, press the TALK button. When this station is dialed, answer the phone and press the DATA button. When the DATA button is lighted, communication is established.
4. Start program execution.

### Operating Notes

1. Check to ensure that the same Data Set model is being used at both stations.
2. Check to ensure that the Speed Selection switch on both stations is turned to the same Baud rate.
3. Before starting program execution, check to ensure that the READY light on the 1130 Console is on.

The following considerations should be kept in mind by the user when programming using SCAT1.

1. The 4-of-8 code contains 64 valid data characters; however, some STR devices do not utilize all of the 64 data characters. The 1130 Computing System can recognize any or all of the 64 data characters as directed by the stored program, but the programmer should determine the character set recognized by the remote STR devices to avoid sending invalid characters.
2. If the user's error routine returns to SCAT1 with a zero accumulator, SCAT1 performs a Close operation. Before another Transmit or Receive operation can be performed, an Open operation must be performed. Otherwise, pre-operative errors result on subsequent attempts to Transmit or Receive.
3. After the completion of one Receive operation and before the initiation of another Receive operation, the user should check to determine if EOT was received, i.e., the word count preceding the I/O area has been set to zero.
4. For maximum throughput, double buffering of the I/O area is recommended.
5. The user must be conscious of any special characteristics of the stations communicating with the 1130, e.g., record sizes, valid character sets, and ILRC requirements.
6. The user should avoid reverting to handshaking between data records. Handshaking between data records results in the inefficiencies illustrated in Figures 2 and 3. In the illustrations below, both stations, A and B, are 1130 Computing Systems. The Sync-Reg shown is the idle register in the 1130 SCA that contains the character that must be received by the SCA before a read response interrupt is issued. This register is manipulated by SCAT1.

   Figure 1 shows the initial handshaking, the normal sequence of communication when handshaking does not occur between data records, and the normal end of transmission.

   Figure 2 shows the sequence of communication when the transmitting station, A, reverts to one handshaking sequence between data records.

   Figure 3 shows the sequence of communication when the transmitting station, A, reverts to more than one handshaking sequence between data records. Note that, if the transmitting station, A, continues handshaking at POINT C, the receiving station, B, does not time out again until A transmits the data record.

The following considerations should be kept in mind by the user when programming using SCAT2.

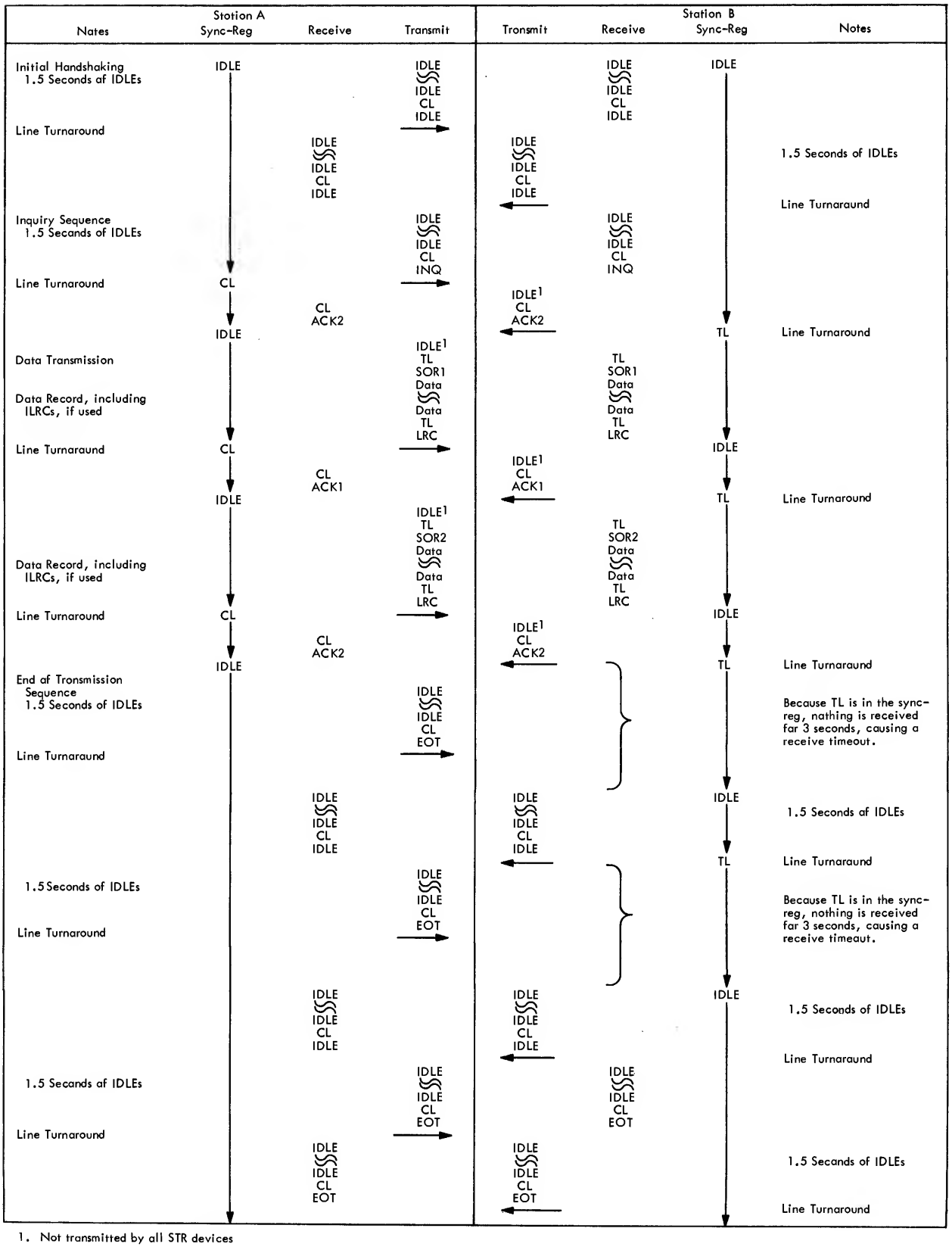
1. If the user's error routine returns to SCAT2 with a zero accumulator, SCAT2 performs a Close operation. Before making subsequent attempts to transmit or receive, the user should check to determine if a Close operation has been performed by SCAT2 as directed by the error routine.
2. After the completion of one Receive operation and before the initiation of another Receive operation, the user should check to determine if EOT or the DLE EOT sequence was received, i.e., the word count preceding the I/O area has been set to zero or $FFFF_{16}$, respectively.
3. For maximum throughput, double buffering of the I/O area is recommended.
4. The user must be conscious of any special characteristics of the stations communicating with the 1130, e.g., record sizes and valid character sets.

The following considerations should be kept in mind by the user when programming using SCAT3.

1. After the completion of one Receive operation and before the initiation of another Receive operation, the user should check to determine if EOT was received, i.e., the word count preceding the I/O area has been set to zero.
2. The user must initiate a Receive Initial or Transmit Initial before initiating any other Receive or Transmit operation. In addition, the user should check, before initiating a Receive Continue, Receive Repeat, Transmit Continue, or Transmit End operation, to ensure that SCAT3 has not returned to the monitoring operation.

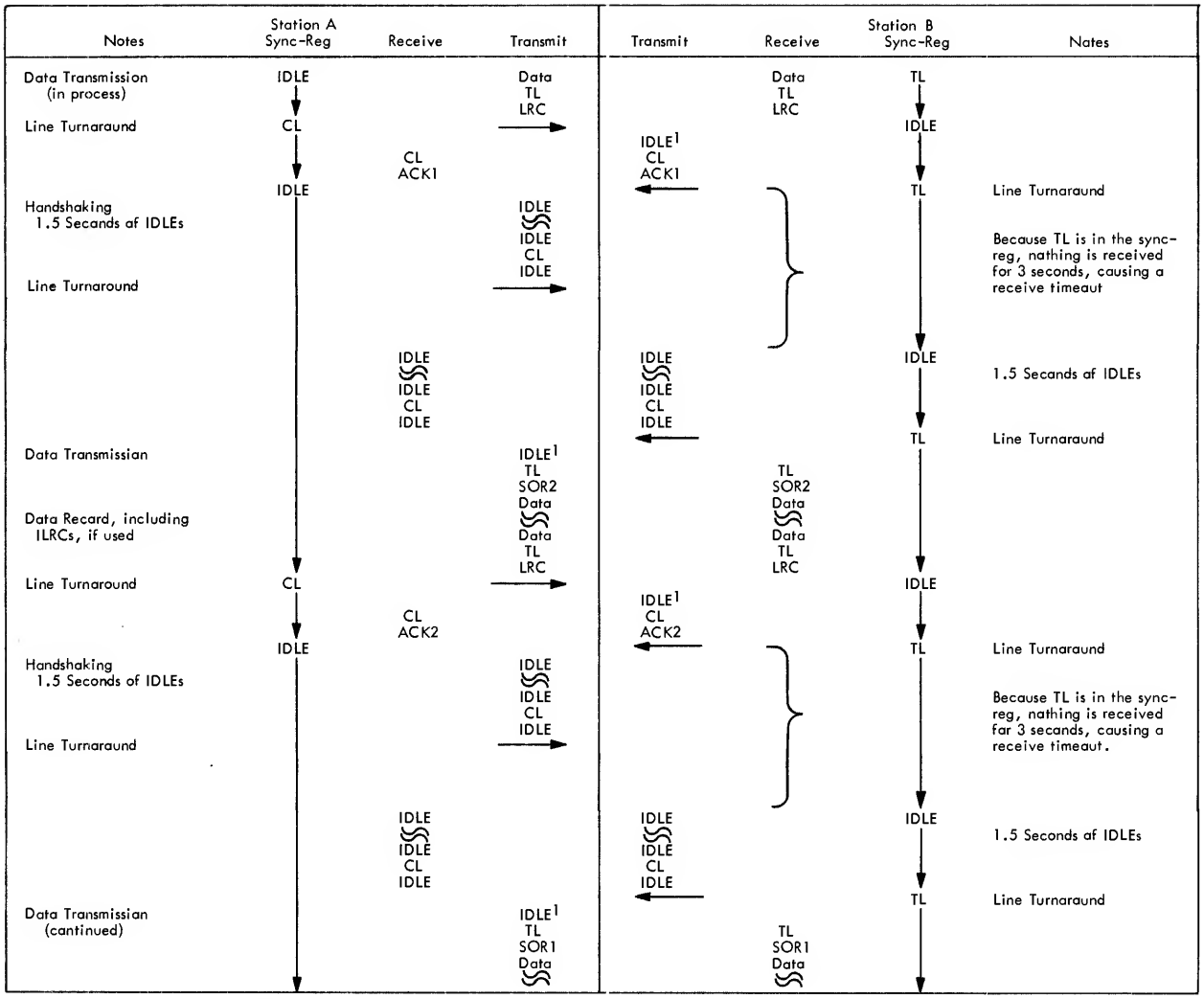
3. Once a Monitor operation has been initiated, another Monitor operation must be initiated only if a Close operation has been performed since the last Monitor operation was initiated.
4. For maximum throughput, double buffering of the I/O area is recommended.
5. The user must be conscious of any special characteristics of the station(s) communicating with the 1130, e.g., record sizes and valid character sets.

In programming error routines to be used by SCAT1, SCAT2, and SCAT3, the user must keep in mind that (1) if an ISS is called in the error routine and the device serviced by that ISS is on an interrupt level having a priority lower than the SCA (level 1) and (2) if, before the operation of the ISS called in the error routine is completed, the error routine is re-entered, then an endless loop occurs in the error routine waiting for the called ISS to be "not busy".



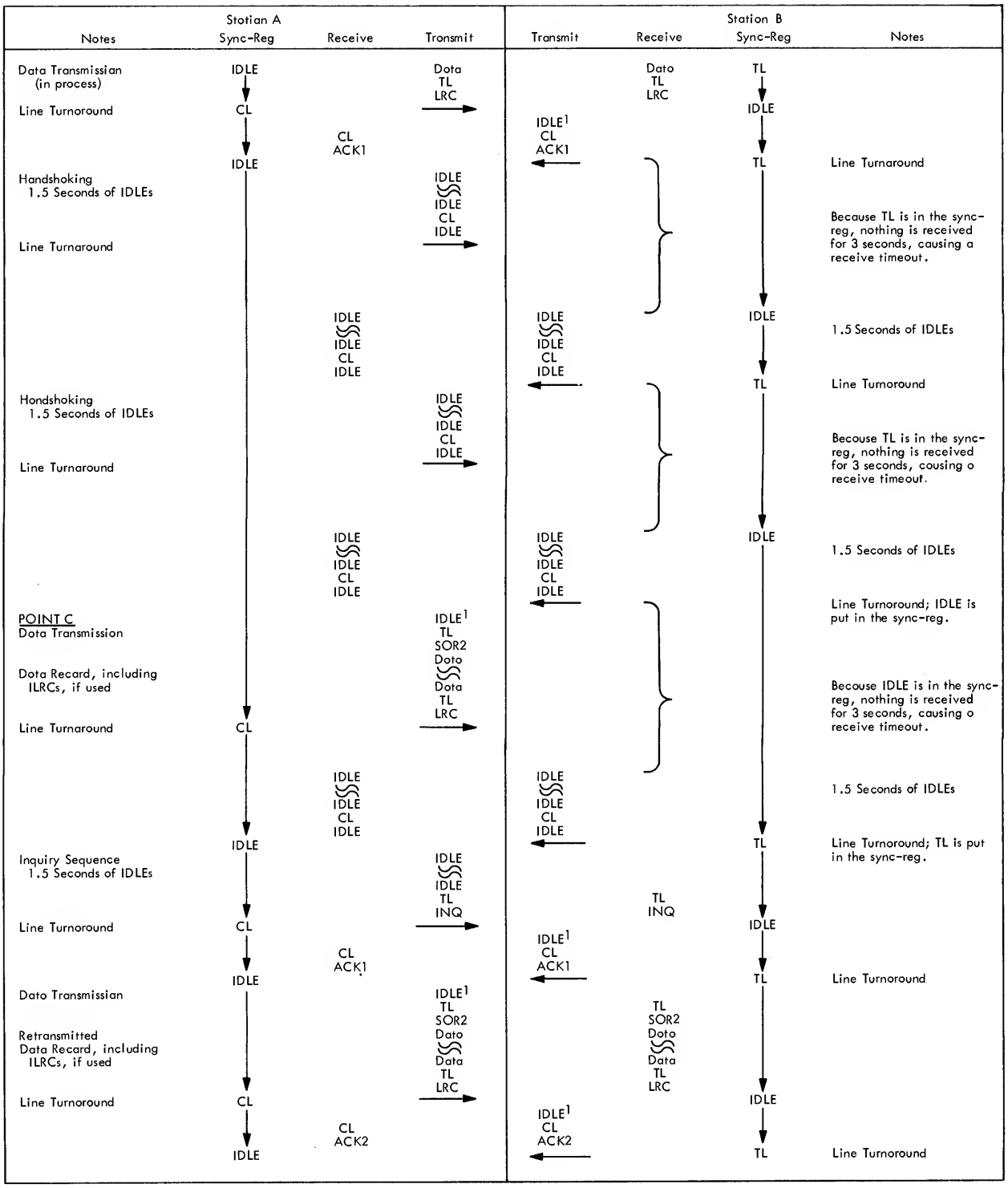

1. Not transmitted by all STR devices

Figure 1. Communication Sequence, Normal Operation




1. Nat transmitted by all STR devices

Figure 2. Communication Sequence, One Handshaking Sequence Occurring Between Data Records




1. Not transmitted by all STR devices

Figure 3. Communication Sequence, More Than One Handshaking Sequence Occurring Between Data Records

## INDEX

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